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ABSTRACT

The legitimacy of writing as a science activity is supported in this paper and ways of incorporating it in an elementary science program are suggested. Reasons are delineated on how writing can help students improve their skills in the areas of critical thinking, problem solving, questioning, and concept clarification. Specific activities are offered for classroom use. These include exercises dealing with: (1) the use of fantasies; (2) science fiction writing; (3) story endings; and (4) science, technology and society themes. Sources of additional ideas of writing activities are also identified. A list of 16 references is included. (ML)

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Don't Overlook Writing as an Activity in the Elementary Science Classroom

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In the present-day technological society where the word processor steadily replaces the typewriter and the pen, the skill of written communication becomes ever-important. It has been suggested that we have moved from an industrial base into an "information society" (Garfield, 1978). As early as 1978 it was estimated that over 50 percent of the work force was employed by the information industry which generated over 50 percent of the gross national product (Molnar, 1978). Hade (1982) suggests that literacy in the information society requires competency in obtaining information as well as transmitting information. In short, communication is a two-way street.

In view of the importance of writing skills in our society, it is alarming to witness the plethora of concern in the media regarding the lack of writing skills among graduating high school seniors. The 1983 National Science Board Commission report "Educating Americans for the 21st Century" noted a concern for the writing skills of students and recommended that science courses include the solution of practical problems to improve writing precision (The National Science Board, 1983).

A recent report by the National Assessment of Educational Progress (NAEP, 1986) indicates that some students in grades 4,8 and 11 can write

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adequately if not asked to elaborate or organize. A minimum number are able to write well. Only 20-25 percent can perform written analysis through comparison, explanation, contrast and support of a position. Less than 30 percent of eleventh graders in the United States can write an acceptable persuasive paper while only 18 percent can demonstrate competency in writing imaginative papers. Although writing ability correlates with positive attitude, the attitudes of students toward writing deteriorates with each grade advancement. The NAEP report recommended specific teacher action to help students develop:

Analytical Writing Skills
stress the development of higher-order thinking skills in all areas of the curriculum. Help students develop strategies for thinking about what they write. Respond to the ways in which they organize and present their ideas.

Positive Attitudes Toward Writing
Show enthusiasm for the value of writing. Encourage and support student efforts. Provide positive feedback on student papers. React to student ideas, so they know you are reading and responding...not just "correcting" their papers.

Adequate Imaginative Writing Skills
Encourage and assign imaginative writing experiences. Ask students to apply their knowledge to new situations in various content areas; e.g., in science, use what they know about human systems to imagine the world of the future. Build upon the vivid imaginations students bring to the early grades.

In order for elementary teachers to foster good writing skills in their students, it would seem reasonable that the teachers themselves be able to write well and to possess a healthy respect for writing. The author has, for a number of years, fostered a deep concern for the writing abilities demonstrated by elementary education majors enrolled in his physical science classes. A predominant number of them cannot develop a

precise, parsimonious, sequential laboratory report incorporating good syntax. Through the use of feedback comments and rewrites of laboratory reports and three assigned theme papers per semester, it has been a personal observation that writing habits can be improved.

Although the development of writing skills is a noble endeavor, we can easily overlook the use of writing itself as a tool for the teaching of science. Unfortunately research in the field (Helgeson, et.al., 1978; Weiss, 1978) indicates that elementary teachers tend to shy away from the teaching of science due to feelings of inadequacy in respect to science subject matter background and teaching activity-based science lessons which motivate the children. These same teachers most likely would feel comfortable in teaching writing activities. A rationale for writing as a legitimate science activity can open a new and exciting vista for teaching elementary school science.

Olson (1984) advocated writing as a learning tool for refining and elevating critical thinking skills. She views the teacher as a facilitator and guide who structures an environment which fosters learning through discovery. Learning theorists such as Bloom, Taba, Bruner, Gagne' and Piaget view the development of the child as sequencing from the concrete to more abstract levels of thinking through interaction with the immediate environment. Such activities may well transpire through mental manipulations involved in formulating, sequencing, evaluating and reformulating during the process of writing about some concrete object or phenomenon. Writing in science is too often done in the form of testing or fill-in the blank activities.

Piaget, whose work has been the basis for considerable research and curriculum development in science education, has stressed the necessity of a child interacting with his/her environment through concrete manipulatives progressing from disequilibration to equilibration, thus achieving a higher cognitive structure. Emphasizing the importance of direct actions of the child, Piaget stated (cited in Wadsworth, 1979, p.141):

> Experience is always necessary for intellectual development ... but I fear that we may fall into the illusion that being submitted to an experience (a demonstration) is sufficient for a subject to disengage the structure involved. But more than this is required. The subject must be active, must transform things, and find the structure of his own actions on the objects (p.4).

Socialization is a necessary process in the development of children , according to Piaget. He argued, for example, that liberation from the pre-operational egocentrism takes place mainly through social interaction with peers. Wadsworth summarizes (1979, p.98):

> Piaget states that social interaction is one of the variables that facilitates cognitive development. His writings suggest that social interactions are any behaviors (conversations, play, games, etc.). that involve a real interchange between two or more persons. Thus, when language becomes functionally communicative, it is a form of social interaction.

Randall R. Freiseinger, professor of composition and rhetoric (1980) believes that language becomes functionally communicative when it becomes an expressive function to learning. Writing can become part of the inquiry process through problem-solving, questioning, group work and self-directed objectives. Promoting closer written expression should

encourage the open-ended investigation of new experiences. Freisinger argues that cognitive development can be augmented by fostering "accommodation" through writing serving as a personal connection.

Writing then, is a legitimate way of learning. Clarification, application and description through active writing in and about science will allow students to bridge prior knowledge with present learning. James Howard (1984) considers writing as "an essential means of learning, and the best reason for writing in school is to learn".

There may be those that find writing as a legitimate science activity bothersome. Space radiation physicist James Van Allen defines science as a "mixture of many different types of perceptions and understandings. Verbalization is only one of the constituents of science...for nothing will persuade me that writing is not an essential part of doing science".

The so-called " new" science curricula or "funded" curricula were designed around inquiry learning and focused on involving students in activities. One consistently hears statements to the effect that such courses were not successful and ignored the "basics". A meta-analysis of 105 experimental studies across over 45,000 students indicates the performance of elementary students exceeded over 61% of the students enrolled in traditional programs. Students involved in the new science curricula also showed superior gains in mathematics skills, reading skills, social studies and writing and speaking skills (Shymansky, et. al., 1983). Students seem to like science better when they are taught

through the inquiry process. Arguing that science instruction should emphasize critical thinking and problem-solving skills, Shymansky, et. al., (1982) urges science instructors to use reading, writing, speaking and mathematics for more effective teaching/learning of science as well as the enhancement of "basic"skills.

Suggested Activities

Writing in and about science can promote cognitive development, enhance student learning of science, enhance student attitude toward science, develop analytical skills and teach communication skills. A minimum amount of materials and preparation time is required for this activity which involves each individual child in the entire class.

Recently, the author was asked to introduce a unit on plants to a first grade class. A reward arrived a few weeks later in the form of a 12" x 18" book produced by the entire class. The cover was beautifully done, consisting of a construction paper representation of a plant in several colors. Each student in the class was given responsibility for one page in the book. The top half of each page contained a crayon drawing of the student's plant grown from a seed donated during the presentation, and the bottom half contained a letter reporting the progress of the plant and a statement of appreciation for the presentation. The imaginative teacher had expanded the plant lesson into making observations, reporting, practicing penmanship and letter formation, developing art and practicing the social skill of showing appreciation. Considerable mileage indeed, from a single presentation!

It is believed that the Western Culture reinforces left hemispheric functions of the brain at the expense of right hemispheric functions. Carin and Sund (1980) suggest "vitiminization" of the right hemisphere of the brain through generating metaphorical thought. Children can be encouraged to write about metaphoric titles such as "What is a plant like?', "How is a stone like a piece of cheese?", "How would it feel to be a puppy?", "A cloud is not like __." and "How would it feel to be a raindrop?". The use of fantasies may also be used for fostering right hemispheric development. Children may write fantasy stories about trips they have taken, stories they have read or have had read to them and physical or biological phenomena they have observed.

Writing science fiction can help develop imagination and creativity. Children are interested in space travel, other worlds and the future. Such topics as "What will your home be like in the year 2000?" or "Describe what automobiles will be like 100 years from today" will stimulate interest and creativity.

A story may be partially begun through reading, a video tape or a motion picture. The children may be asked to write an ending to the story. Or, the later part of the story can be read to its finish and the students asked to write how it began.

Science/society/technology issues may be the topic for student writings.

Such activities can foster appreciation for the environment and create an awareness of rudimentary implications of the the impact of science and technology on our society and environment.

An excellent source of ideas on writing activities for elementary school science can be found in the January 1977 issue of Science and Children (Reid & McGlathery, 1977). A variety of theme ideas from "Picnic Pets", "Erosion", "Daydreaming", Girabbit", "Sleuthing",. "Inventor", "Interview", "Visit another planet", to "Haiku" are suggested with descriptors.

Newspapers and magazines are loaded with stories and illustrations about science related issues about the environment, social issues, health problems and space exploration. All of these, with a little imagination can make excellent topics for writing.

Writing is a legitimate science activity. Through writing, students can experience personal activity in creating, analyzing, revising, developing logical progression and expression. Writing is another example of the inquiry process. Research shows that children like science better when taught through inquiry. Science in grades K-8 should promote interest, not focus on amassing information (Shymansky, et.al., 1982). Add writing to your repertory of science teaching procedures.

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